Armed Forces College of Medicine

AFCM

Lung Compliance

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INTENDED LEARNING OBJECTIVES (IL

By the end of this lecture the student will be able to:

1. Outline the elastic properties of the lung.
2. Define lung compliance and mention its normal value.
3. Describe the curve of the lung compliance.
4. List the factors affecting lung compliance.
5. Define the work of breathing & name the conditions that increase it.

Elastic Properties of the Lung

Compliance

Refers to forces promoting ex
of the lung.

Refers to how much effort is r
stretch or distend the lu

It is an index for lung distens

Elastic recoil

Refers to forces that restores
resting volume

Refers to rebounding of lungs
been stretched

It is responsible for returnin
to their pre-inspiratory

Lung Compliance

Def:

It is the change in lung volume **(□V)** per unit change in ***trans-pulmonary*** pressure **(□P).**

e.g if a small change in distending pressure causes a large change in lung volume, this lung is said to be highly compliant = easily inflated lung. ***(a lung that expand easily has high compliance)***

So a highly compliant lung requires less work to be inflated.

The compliance of the chest wall: is the change in lung volume **(□V)** per unit change in ***trans-thoracic*** pressure **(□P).**

$$\text{Compliance} = \frac{\square V}{\square P}$$

N.B

Lung Compliance

- **Normal values:**

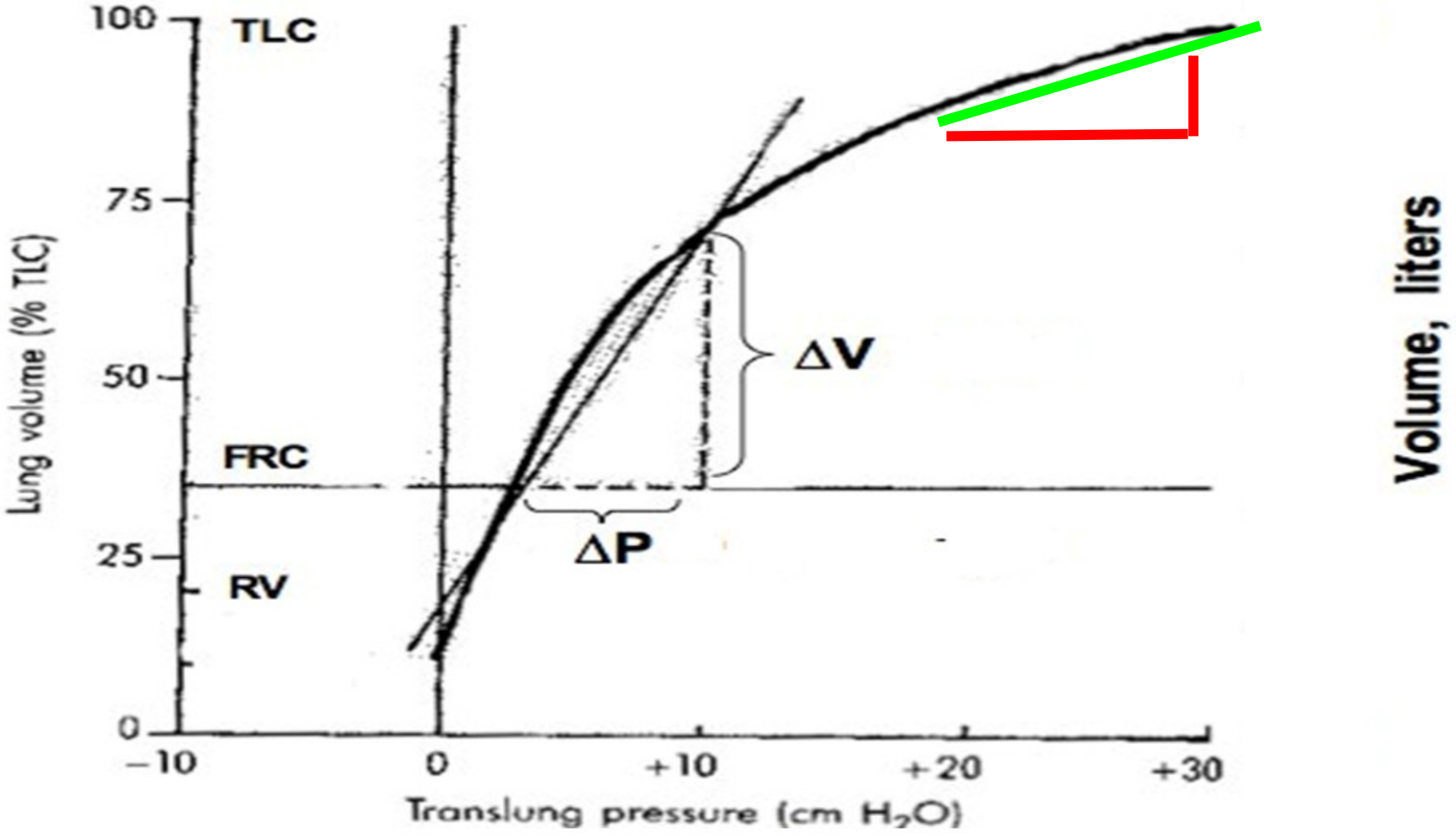
g compliance = 0.2 L/cm H20 trans-mural pres

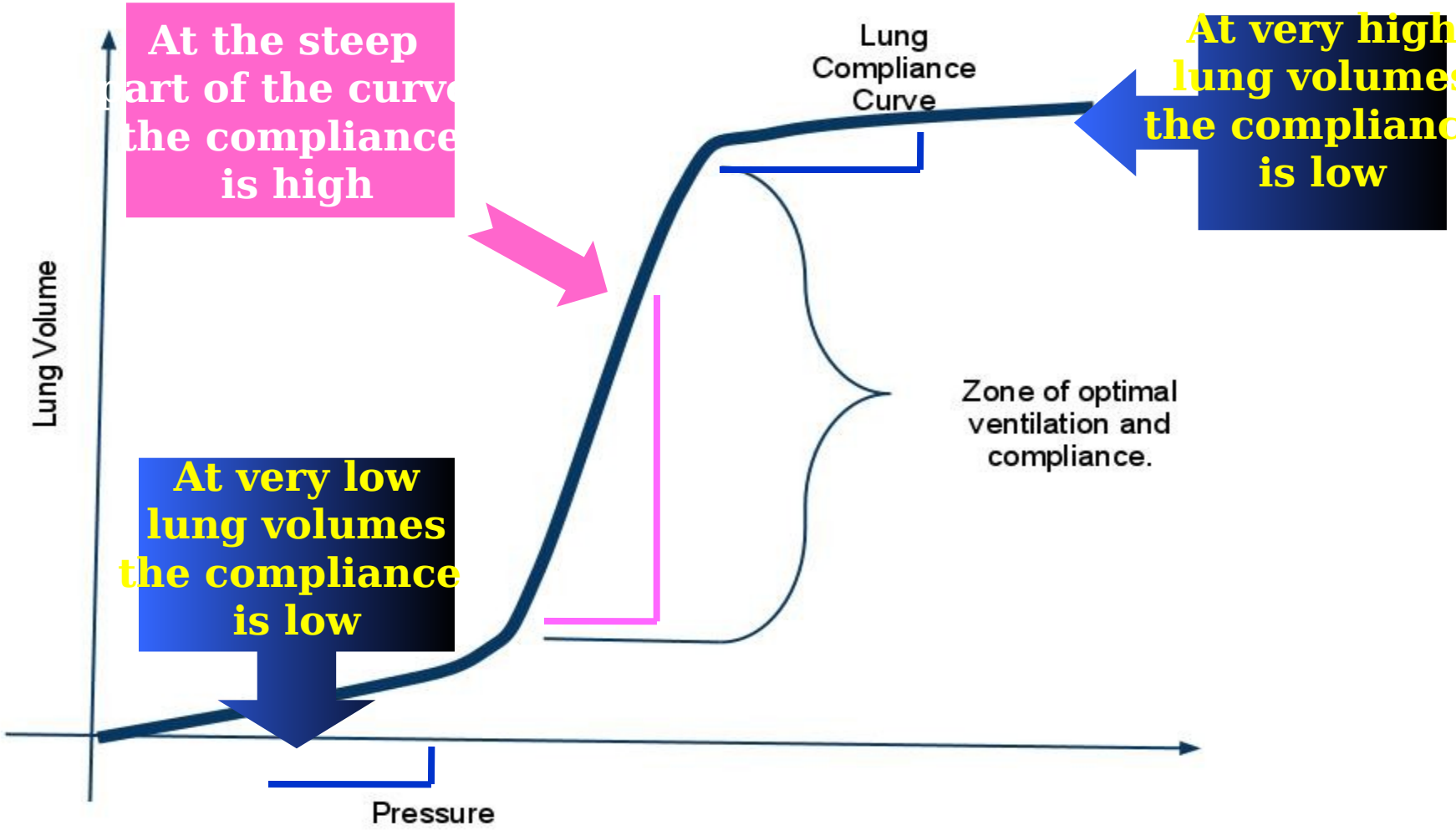
- i.e an ↑ in trans-pulmonary pressure by 1 cm H20 ⇨ expansion of the lungs by 0.2 L (200ml).

- The compliance of the lungs& chest wall is 0.1 L/cm H20 trans-mural pressure.
- So the compliance of the lungs& chest wall together is less than the lungs alone because the lung distensibility in chest is limited by the rigid thoracic wall.

$C = \Delta V/\Delta P$

where V is lung volume and P is pressure





Compliance = Change in volume/ Change in pressure

Lung Compliance

- **Importance of lung compliance:**

  It is a measure of distensibility or expandability of the lungs (or how easy the lung is stretched).
- A lung which expand easily has a high compliance
- A lung with increased elasticity (elastic recoil) is harder to inflate
- ***Thus, compliance is the Inverse of elasticity.***

↑ Compliance

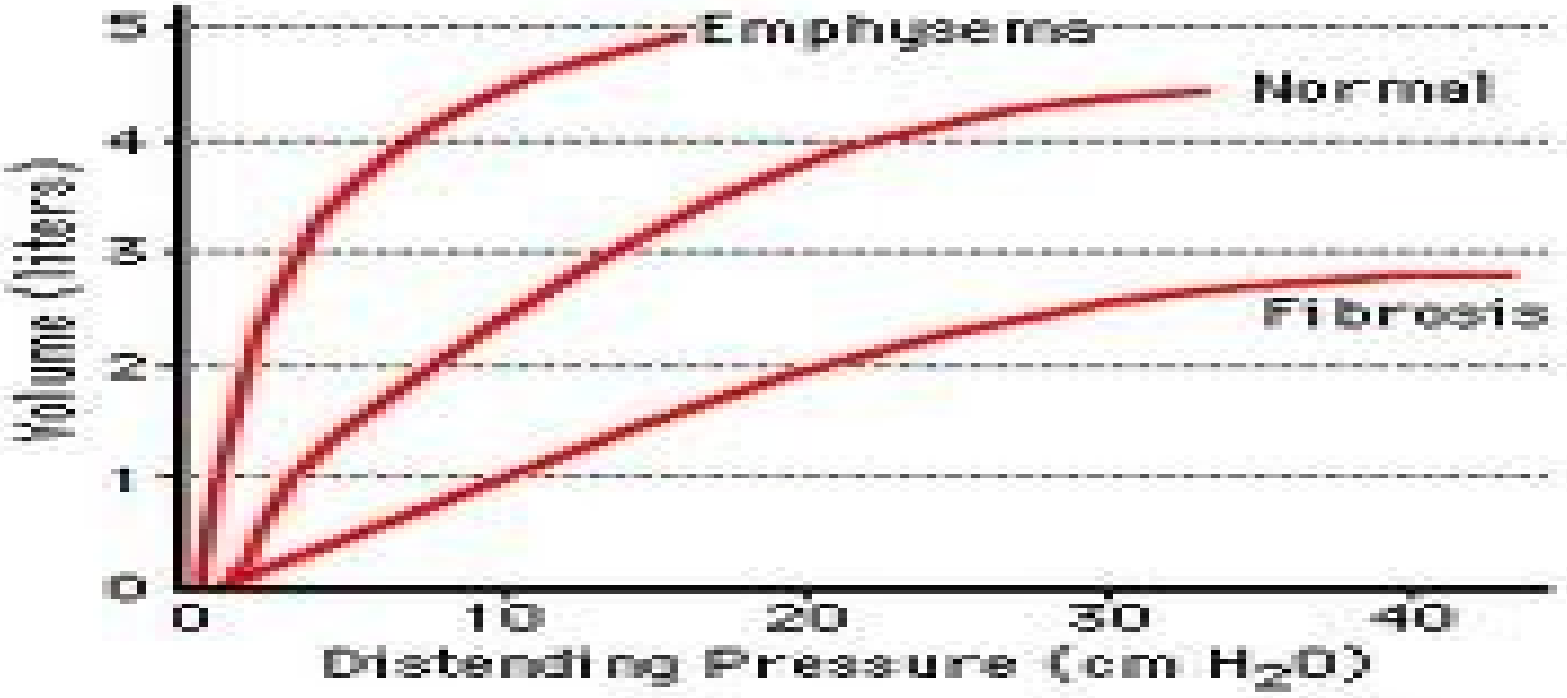
Less pressure gradient & less work is needed to inflate the lung as in:

1- Elderly.
2- Emphysema.

↓ Compliance

More pressure gradient & more work is needed to inflate the lung as in:

1- Pulmonary congestion, edema.
2- Pulmonary fibrosis.
3- Respiratory distress syndrome.
4- Persons with one lung (pneumonectomy).



In loss of lung elastic tissue, there is a great difficulty in expiration due to:

1. ↓↓elastic lateral traction collapse (closure) of small airways ↑↑ airway resistance.
2. ↓↓ elastic recoil makes passive expiration not enough to empty the lungs, so abdominal muscles contract at rest (active expiration) ↑↑ the work of breathing.

Elastic recoil of the lungs (Elastance

- Refers to how the lungs rebound after being stretched.
  i.e a lung with increased elasticity (elastic recoil) is harder to inflate
- Elastic recoil is due to the elastic forces in the lung

Elastic forces in lungs is caused by

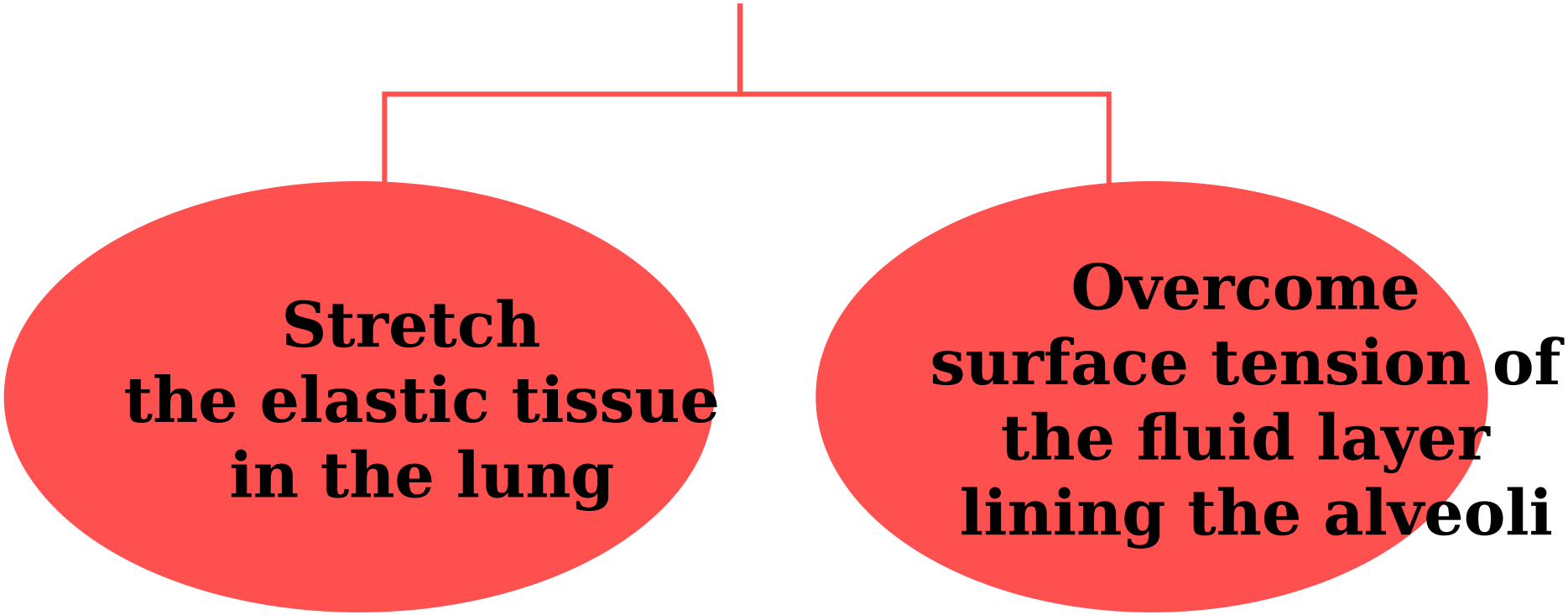
Elastic tissue in the lung (1/3)

- Which is the elastin & collagen fibers
  present in throughout the lung tissue
- So it can be distended & once the

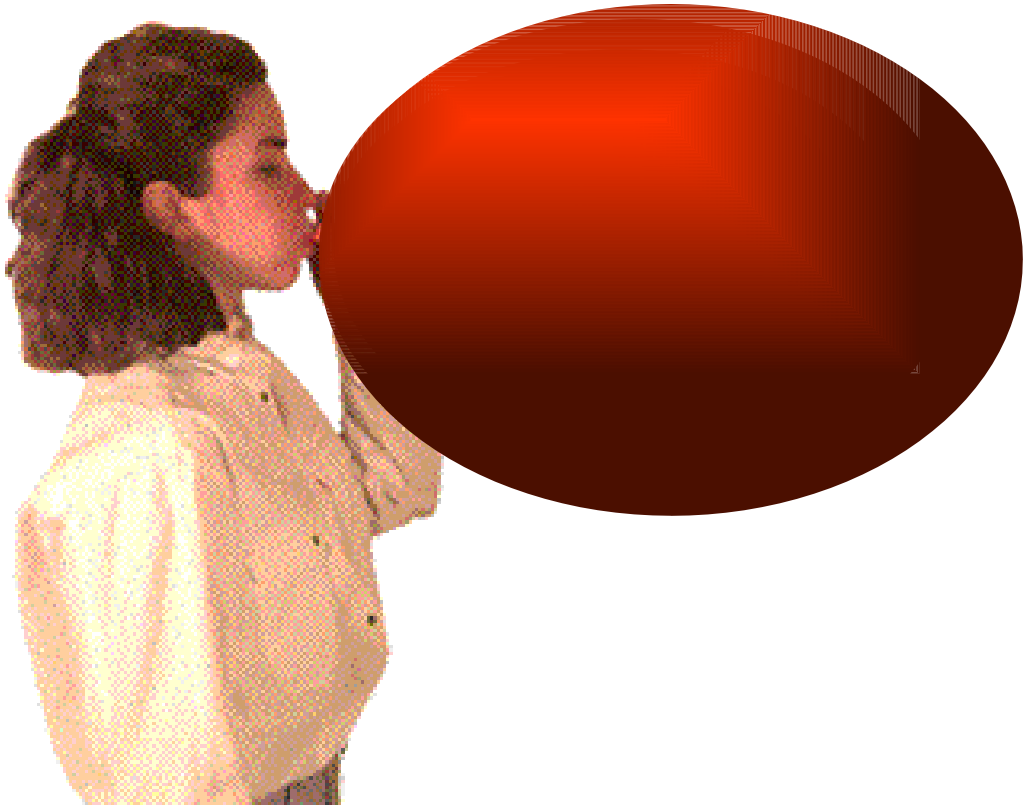
Alveolar surface tension (2/3)

- It is the attractive forces between the
  H20 molecules of the fluid film that line
  the alveoli
- This surface tension tend to

So lung expansion needs energy to



Healthy lungs are highly compliant due to the presence of elastic tissues , surfactant & residual volume in the lungs that facilitate their expansion



Like fibrosis in which less flexi connective tissue develops

The Work of Breathing

Def:

- It is work performed by the respiratory muscles during breathing.

- During normal quiet breathing, inspiration is active & work is done but expiration is passive so NO work is done.

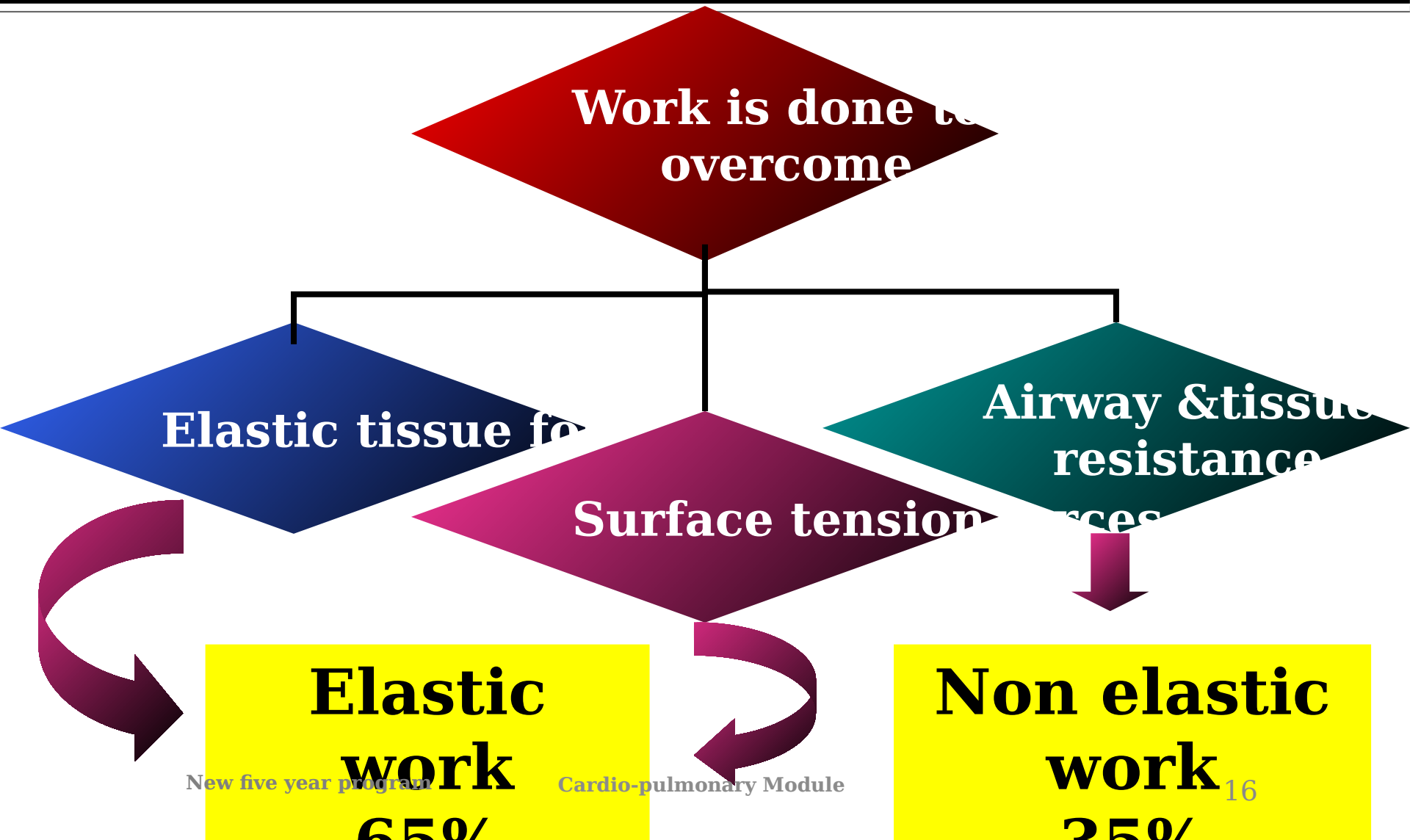
There are 2 types of work:

1- Elastic (compliance) work (65%):

It is the work done to expand the lung against elastic tissue forces & surface tension forces.

2- Non elastic (Resistive) work (35%):

It is the work done to overcome air way

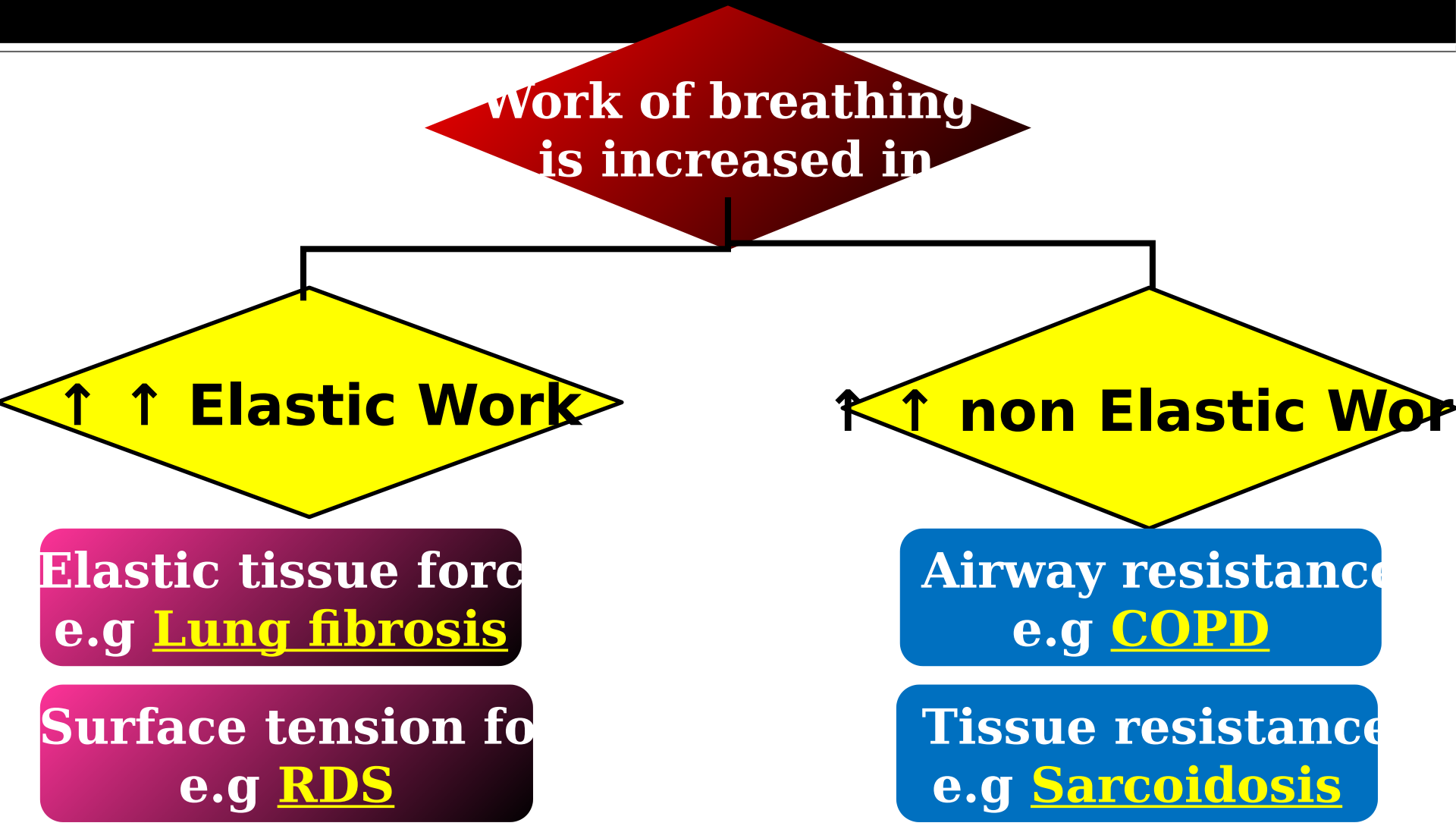

Work is done t
overcome
Elastic tissue fo
Airway &tissu
resistance
Surface tension
rces
Elastic work 65%
Non elastic work 35%

- **Normally, our lung are highly compliant & air resistance is low so the work of breathing constitutes**

3% of total energy expenditure during quiet breat

5% of total energy expenditure during exerc

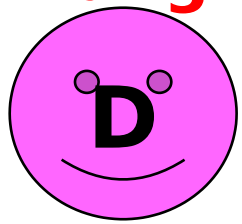
30% of energy expenditure in patients with COPD



N.B: The work of Breathing increases by increased

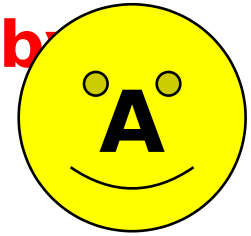
Quiz

1- Which of the following is incorrect about lung compliance?



a. It is equivalent to □V/□P.
b. It increases in elderly.
c. A highly compliant lung requires less work to be inflated.
d. It increases in patients with surfactant deficiency.

2. Which of the following is accompanied by reduced lung compliance ?



e. Patients with pulmonary fibrosis
f. Athletes.
g. Old age people.
h. Patients with emphysema.

SUGGESTED TEXTBOOKS

1. Ganong's Review of Medical Physiology. 23rd edition , chapter 35, page 595,596.

2. Kaplan Medical USMLE step 1 lecture notes. Section VII, chapter 1. Pages (157-159).

3. Guyton & Hall: Textbook of Medical Physiology, 12e. (37) page 875


Thank You